

# Research Division

Tools for Better Transportation Tomorrow

[Research Home](#)[Published Reports](#)[I-15 Test Bed](#)[Contact Us](#)[Links](#)

What's  
Hot

February

In The Know

2007

Completed  
UDOT  
Research

News

Need a  
Literature  
Search?

Letter



## What's HOT

### You Think You Have Problems?

Well, we hope you do.

*By: Blaine Leonard, UDOT Research Division*

The annual UTRAC Workshop, sponsored by the Research Division, is scheduled for March 6, and we are all bringing our problems. The UTRAC Workshop is the venue where we gather together to discuss the research needs of UDOT, and decide which ones are the highest priority. People from UDOT, FHWA, the Universities, consulting firms, contractors, and vendors will come together, armed with Problem Statements describing their needs, to discuss, evaluate, and prioritize these needs. To facilitate these discussions, the participants will gather in small discipline-specific groups, including construction, maintenance, materials & pavements, environmental, planning & asset management, traffic management & safety, geotechnical, structural, and hydraulics. The highest priority Problem Statements selected by each of these groups will be considered for funding by the Research Division.



Last year, at the 2006 UTRAC Workshop, Executive Director John Njord recounted how UDOT has “reinvented ourselves a number of times . . . in the way we do business, the way we deliver projects, and the way that we go about our business.” He noted that this has set a standard for many other transportation agencies across the country. Many of UDOT’s innovations are generated from this UTRAC Workshop. John indicated that the UTRAC Workshop was a “great opportunity. . . to gather together to talk about research and opportunities to deliver our projects better, faster, and with higher quality, to make our projects longer lasting and more beautiful.” The AASHTO President’s Award for Research was given to UDOT for this innovative process in 2005, and John encouraged us to meet the needs of our customers by identifying and developing research projects focused on those needs, adding that he was “proud and honored to be part of this process.”

The UTRAC Workshop and the management of research contracts generated at the workshop is a major role of the Research Division, and is one of the ways that we help UDOT move forward with innovation, changing the way UDOT does business. In 2006, 64 Problem Statements were considered at the workshop, and 19 were ultimately listed for funding. The amount of funding applied to these new projects was \$1.04 million.

How do we fund these new projects? Each year, the Research Division receives federal funding to advance the state of practice in transportation. This funding, known as the State Planning and Research (SPR) fund, is matched with state funds, and augmented with funding from the State Construction fund. The Division uses this money to execute research projects in many areas, to help improve design, construction and maintenance practice, to solve problems, to seek new methods and products, to develop better tools, and to advance knowledge and skills. Our projects generate design guidelines, create new specifications, develop or refine policies, provide training, verify performance measurements, and produce needed information. Some of the topics which received

funding last year included evaluating various thicknesses of thin asphalt overlays, developing a plan for seismic upgrades of bridges, studying the impacts of highway culverts on fish migration, assessing the safety of rural roads using a new FHWA model, developing a methodology to measure the indirect impacts of road construction on wildlife, enhancing the effectiveness of stone column installation in silty soils, improving our ability to predict stream flow in ungaged streams, and finding ways to improve the tracking of highway assets. Our projects cover a very broad spectrum.



Rukhsana Lindsey, Director of Research, presents the UTRAC Trailblazer Award to Dr. Lawrence Reaveley, Chair of the University of Utah Civil and Environmental Engineering Department, for his longstanding support of and participation in transportation research.

Problem Statements are prepared and submitted in advance of the Workshop. They can be submitted through the leader of the discipline group or directly to the Research Division. Problem Statement forms, a list of the group leaders and other pertinent information are provided on the Research web site under the UTRAC 2007 topic.

The 2007 UTRAC Workshop is being held at the Salt Lake Community College Larry Miller Campus in Sandy. For more information about the workshop, review the information on our web site, or contact Blaine Leonard (965-4115), [bleonard@utah.gov](mailto:bleonard@utah.gov) in the Research Division. We know you have problems, and we want to know what they are!

## **Motorists in Salt Lake City to benefit from new type of left-turn traffic signal**

*By: Mark Taylor, UDOT Traffic Operations Center; Barry Sharp, UDOT Research Division*

**SALT LAKE CITY** – To increase safety and provide better mobility, Salt Lake City and the Utah Department of Transportation (UDOT) will be using a new type of left-turn traffic signal at the following three intersections along Sunnyside / 800 S. in Salt Lake City:

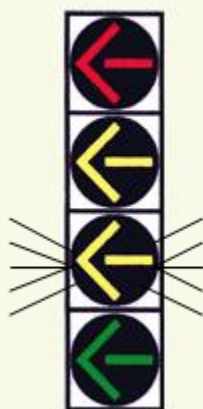
- 800 South & 1300 East
- Sunnyside Ave. & Guardsman (1580 East)
- Sunnyside Ave. & Arapen Way (2210 East)

The proposed flashing yellow arrow for permissive left turns will be a limited study at the three intersections listed above. If Salt Lake City and UDOT find it successful and easily understood, then other areas will be pursued for further implementation around the city and state.

The flashing yellow arrow traffic signals consist of four arrow lights stacked vertically in one signal head display. The signal will be used in lanes that are exclusively for left-turning traffic. The arrow traffic signals are separate from the traffic signals containing circular lights for through traffic.

The two main reasons this new type of left turn traffic signal is being evaluated are to increase safety and provide better mobility.

### **Here is what the new signals will look like:**



Steady red arrow = Stop. No left turns allowed.

Steady yellow arrow = Prepare to stop.

Flashing yellow arrow = Left turns allowed, but must yield to oncoming traffic.

Steady green arrow = Left turns allowed.

Over a 7-year period, a very comprehensive nationwide study by the Federal Highway Administration (FHWA) was conducted, including engineering analysis, static and video-based driver comprehension studies, field implementation, video conflict studies, and crash analyses. Some of the key findings of the safety-related items of the research include:

- Motorists responded strongly and favorably to the concept with little or no public information; these roadway users intuitively knew what the flashing yellow arrow meant.
- Eliminates the “left-turn yellow trap” and eliminates the need for a red arrow to avoid the left-turn trap.
- Provides quicker preemption for emergency vehicles.

The study found that the flashing yellow arrow for permissive left turns offers more versatility in field applications:

- Allows signal operations to return more easily and more frequently to the left turn condition after serving other movements which results in the ability to provide more left turn time at intersections that have a lot of left turn traffic volume.
- Enables left-turn control to be varied during the day. This can provide more efficient operations by allowing some left turns to be permissive during less congested hours of the day and protected during other congested times of the day.
- Provides the ability to easily implement lead-lag left-turn phasing and/or variable phasing by time of day, without revising signal hardware and without creating the “left-turn yellow trap” that can occur with the traditional circular green display.

Implementation of the new signal head is relatively easy, since it:

- Can be used in all intersection and signal configurations.
- Requires no supplemental signing.
- Does not require optical shielding or precise placement – heads are placed wherever protected left turn heads are normally placed.
- Can also be used for right turns.

Salt Lake City and UDOT will carefully monitor changes in accident patterns and traffic movement at these intersections and will then determine if similar changes to the left turn signals should take place elsewhere.

To view the animation of the proposed new left turn signal, click the link:

[http://projects.kittelson.com/pplt/displays/reno\\_lead.htm](http://projects.kittelson.com/pplt/displays/reno_lead.htm)

To view other information and documentation on flashing yellow arrow research, click the links:

<http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=801>

<http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=800>

<http://projects.kittelson.com/pplt/index.html>

## **Ultra-thin Bonded Wearing Course Placed on Kanab Main Street:**

*By: Ken Berg, UDOT Research Division*

In the summer of 2006, the asphalt pavement on Kanab Main Street (SR-89) needed a surface treatment that would be more durable than a conventional chip seal, provide some lane-leveling ability, and allow reestablishment of traffic within a half an hour of placement. **Larry Gay**, Region Four Materials Engineer, and **Scott Goodwin**, Region Four Pavement Management Engineer, chose Novachip® ultra-thin bonded wearing course to do the job. **Rustin Anderson** was the Field Engineer on the project that extended approximately 2 miles, from the north end of town to the SR-11 intersection.

**Stephane Charnot**, Field Engineering Leader of SemMaterials, distributor of the **Novachip®** technology, contributed the following project information:



**Background:** SR-89 is a key highway bridging Salt Lake City and Phoenix. SR-89 passes through the middle of Kanab, a small and lively town located in the heart of Southern Utah. SR-89 has a high volume of traffic as well as a large percentage of trucks. In 2006, UDOT needed an alternative to conventional chip seals that would allow high speeds, protect the existing structure from



water infiltration and allow traffic to be reestablished within half an hour of placement. An Ultra-thin Bonded Wearing Course (BWC) was found to be the most appropriate solution for this road.



Kanab Main Street before treatment. Note the generalized longitudinal and transverse cracking. Other problems encountered were localized stripping, structural fatigue and delamination.

**Materials and Procedures:** BWC is a paver placed surface treatment, consisting of the application of a warm polymer modified asphalt emulsion membrane, followed immediately with an ultra thin overlay (typically less than 1 inch) of hot asphalt concrete as to produce a homogeneous wearing surface that can be opened to traffic within half an hour of placement. BWC can be placed either on flexible or rigid pavements. Typical thickness is 1/2 inch for Type A, 5/8 inch for Type B, and 3/4 inch for Type C.

**Estimated Life:** Bonded wearing courses have been estimated to last 7 to 12 years.

#### **Installation:**

The bonded wearing course was placed on June 6-9, 2006. The prime contractor for the job was Western Rock, with Sunland Asphalt serving as the subcontractor. The contractor used a Vogeley Spray Paver and Roadtec Shuttle Buggy to place the material. Traffic was placed on the new surface 20 minutes after installation.

#### **Yield:**

Emulsion Yield = 0.159 gal/Yd<sup>2</sup>

Mix Yield = 100.4 lbs/Yd<sup>2</sup>

**Size:** 56,723 Yd<sup>2</sup>

**Cost:** \$6.75/Yd<sup>2</sup>

#### **Implementation:**

UDOT has developed a special provision which specifies the use of the spray paver to place any hot mix asphalt including open, gap and dense graded asphalts. The spray paving technology is finding application on a growing number of thin bonded and other asphalt overlay projects around the country. Scott Goodwin, Region Four Pavement Management Engineer, sums up his opinion by saying, "The real plus for this technology is the short turn around time in getting traffic moving again."

More information about the use of the spray paving technology to apply ultra-thin and other overlays can be found in the article "[Versatility on Trial](#)" in the October 2006 issue of [Better Roads](#).

For questions, please contact Mr. Ken Berg at [kenberg@utah.gov](mailto:kenberg@utah.gov) or 801 965-4321.



Kanab Main Street after treatment with the bonded wearing course at 3/4" thickness



Placement of the material

## Good Roads Cost Less: 2006 Study Update

By: Abdul Wakil, UDOT Research Division

The Utah Department of Transportation (UDOT) office of Research has recently completed the “Good Roads Cost Less updated study”. The principal investigator for this study was Mr. Jeffrey L. Zavitski, of Deighton Associates Limited. The following UDOT personnel have contributed to the completion of this research: Mr. Kim Schvaneveldt, Mr. Gary Kuhl, Mr. Austin Baysinger, Mr. Bill Lawrence, Mr. Dave Blake, Mr. Doug Anderson, Mr. Glen Ames, Mr. Lloyd Neeley, and Mr. Abdul Wakil. The new study once again concluded that good roads do indeed cost less and as stewards of the public infrastructure, UDOT must maintain the highway network in good condition to minimize the impacts on the citizens of the state.

The original study published in 1977 used an economic analysis to recommend the condition level that should be attained for the highway system in order to optimize the benefits and costs. Various pavement rehabilitation strategies were considered through examination of different levels of acceptable performance and their associated benefits and costs. These benefits and costs were reduced to an annual basis considering the life cycle costs for each strategy. Special consideration was given to the benefits and costs to motorists and the State. The potential effect on energy consumption was also determined. A cost estimate to upgrade the State highway system to the levels defined by the strategies was developed.

This objective of the new study was to:

- Update the original study
- Identify pavement performance goals and measures.
- Identify optimum system condition & funding stream required to meet the goals.

This new research takes into account additional factors and data that were unavailable when the first study was undertaken. It recommends performance measures and goals and revisions and modifications to the existing pavement and design manuals. The study determines the

impacts of different performance targets on the network and users of the highway network.

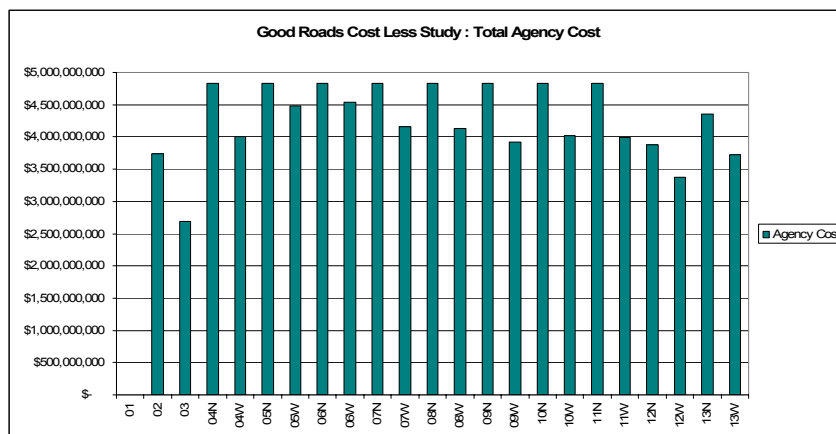
Various strategies within the study show that a deterioration of the Utah highway network condition by amounts of 5%, 10%, and 20% would lead to an increase in user costs, accident costs and an increase in necessary funding to bring the system condition back to current system condition levels. Various strategies also indicate that current UDOT funding is adequate to maintain the highway system in its current condition but not sufficient to increase the system condition if any deterioration of more than 5% occurs.

This study has shown that a poor highway network impacts the economy and the citizens of Utah through increased accident costs, user costs, agency costs and delay costs as larger rehabilitation treatments are needed to restore the highway network to a good condition. Maintaining the network in good condition helps to reduce the impacts to the citizens of Utah.

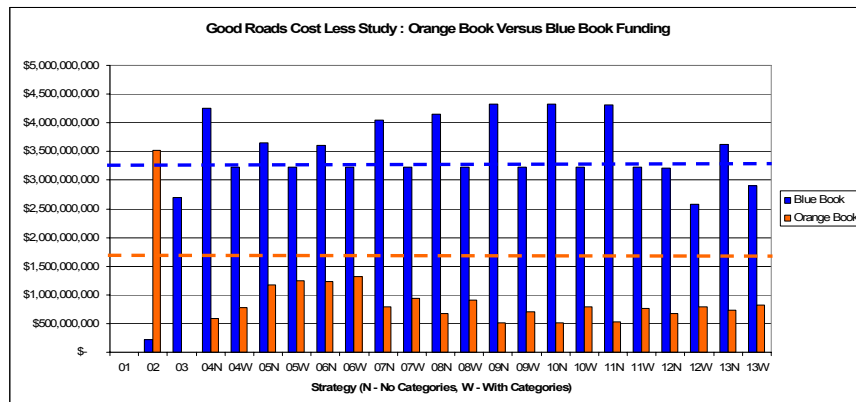
If UDOT did maintain the condition of the highway network at a lower overall condition level (OCI) with significantly less expenditure over the analysis period an increase in accident costs and user costs would occur and the overall structural health of the network would suffer.

The strategies in the study allowed the resulting average condition of the network to vary greatly from highs of 85 OCI to lows of 50 OCI with expenditures ranging from a high of \$4.8 billion to a low of \$2.6 billion for the reconstruction only strategy.

If UDOT were to allow the system to deteriorate to a value of 50 over the analysis period, the difference in costs between the two levels of condition would be approximately \$2.2 billion which is only 13% of the \$16.5 billion of the unmet highway needs outlined in the Utah Transportation 2030 Long Range Plan. After that 20 year period was completed, UDOT's rehabilitation needs would continue to grow substantially as the network deteriorated into poorer and poorer condition.



The preservation and rehabilitation dollars that could be diverted away from the program to fund capacity improvements would

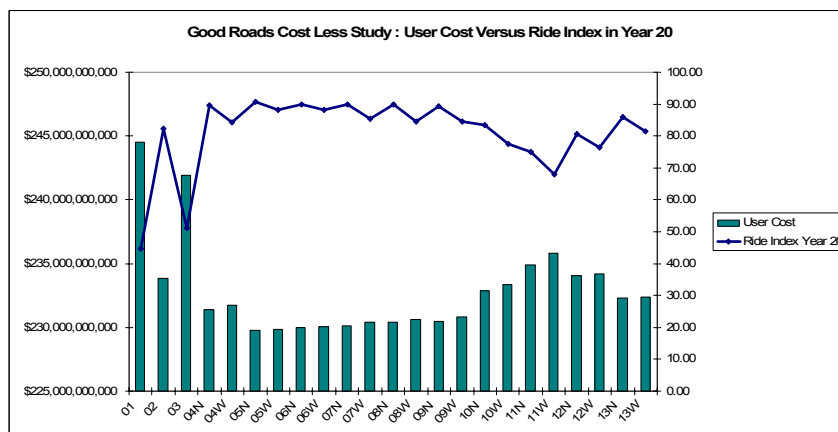


not significantly impact capacity throughout the UDOT network. But that diversion of funds would have a significant impact on the highway network condition and its maintenance and rehabilitation needs in the future and on the user costs, accident costs and delay costs for the citizens of Utah. Clearly, Good Roads Do Indeed Cost Less.

The conclusion and confirmation that Good Roads Cost Less reaffirms the conclusion of the 1977 study, and is based upon the findings of this new study. UDOT must strive to maintain the highway pavement

assets in as good a condition as possible to minimize the impacts on the network to the citizens of Utah. The specific conclusions are summarized as follows:

- Pavements that are in good condition today can be maintained by an appropriate mix of minor maintenance, preservation and rehabilitation treatments that maximize the network OCI and prolong the life of the pavements.
- Pavements that are left to deteriorate to poor and very poor condition cause significant increases in accident costs, user costs, agency costs and delay costs.
- Pavements that are allowed to deteriorate to poor and very poor condition cannot be maintained through minor maintenance treatments as the treatment trigger mechanisms prevent inappropriate treatments taking place on pavements whose condition warrants a more extensive and expensive rehabilitation treatment.
- Pavements that deteriorate enough to bring the overall condition of the network lower by 20% or even by 10% can cause a funding crisis as the need for more expensive rehabilitation treatments raise the agency costs to the point where alternative funding solutions would be necessary.
- Current UDOT funding is sufficient to maintain the UDOT network in good condition but would be insufficient to restore the UDOT network to a good condition if the overall condition of the UDOT network were to deteriorate by as little as 10%.
- Diverting maintenance and rehabilitation dollars to support capacity enhancements (or other facilities or programs) will cause a deterioration of the road network overall condition throughout the analysis and would require a larger influx of money after the initial transfer of funds to restore the network to its current condition.
- When budget categories were used within the analysis, the resulting condition of the network was lower than the resulting condition when no budget categories were used even if no other parameters were changed. This leads to the recommendation that UDOT strive towards being more flexible in determining the funding for minor maintenance and rehabilitation treatments no matter the source of the funds.



To read the full report, please click on the link: [http://www.udot.utah.gov/download.php/tid=1566/2006%20GRCL\(Final\).pdf](http://www.udot.utah.gov/download.php/tid=1566/2006%20GRCL(Final).pdf)

## **In The Know**

### **A Look At Who We Are**

*By: Abdul Wakil, UDOT Research Division*



An ongoing feature of our quarterly newsletter is an introduction to one of our Research and Development Division staff members. In this edition, we will introduce you to Ms. Joni DeMille, Library Technology Transfer Technician.

Ms. DeMille has been with the Utah Department of Transportation (UDOT) for seven years. Prior to joining Research, she was with UDOT Systems Planning & Programming. Joni graduated from Brigham Young University with a B.A. in Theater Arts.

Ms. DeMille is responsible for the Lester Wire Library by providing support and customer service.

She is originally from upstate New York. Her Hobbies: playing piano, her dog, early American history, writing, reading good books and British comedies. She also plays the organ and leads a single adult group. Joni is always willing to help and answer your questions about the library. You can contact Joni at (801) 965-4626 or [jdemille@utah.gov](mailto:jdemille@utah.gov)

---

### **Completed UDOT Research**

Research publications are valuable resources, documenting the results of important research projects. For a list of recently completed Research Projects, please visit the Research & Development website at:

<http://www2.udot.utah.gov/index.php?m=c&tid=235>. If you would like to obtain an electronic copy or a printed copy of our completed research, please contact [awakil@utah.gov](mailto:awakil@utah.gov).



---

### **Need a Literature Search?**

The UDOT Research Division and Lester Wire Library provide an important service through literature searches. These searches help identify published information about a topic of interest. To request a search, provide a brief description and some key words and submit it to [awakil@utah.gov](mailto:awakil@utah.gov). Or you can submit your request online @ <http://www.udot.utah.gov/index.php/m=c/tid=895/>

---

Please send your comments and questions about this Newsletter to Abdul Wakil [awakil@utah.gov](mailto:awakil@utah.gov) or (801) 964-4455